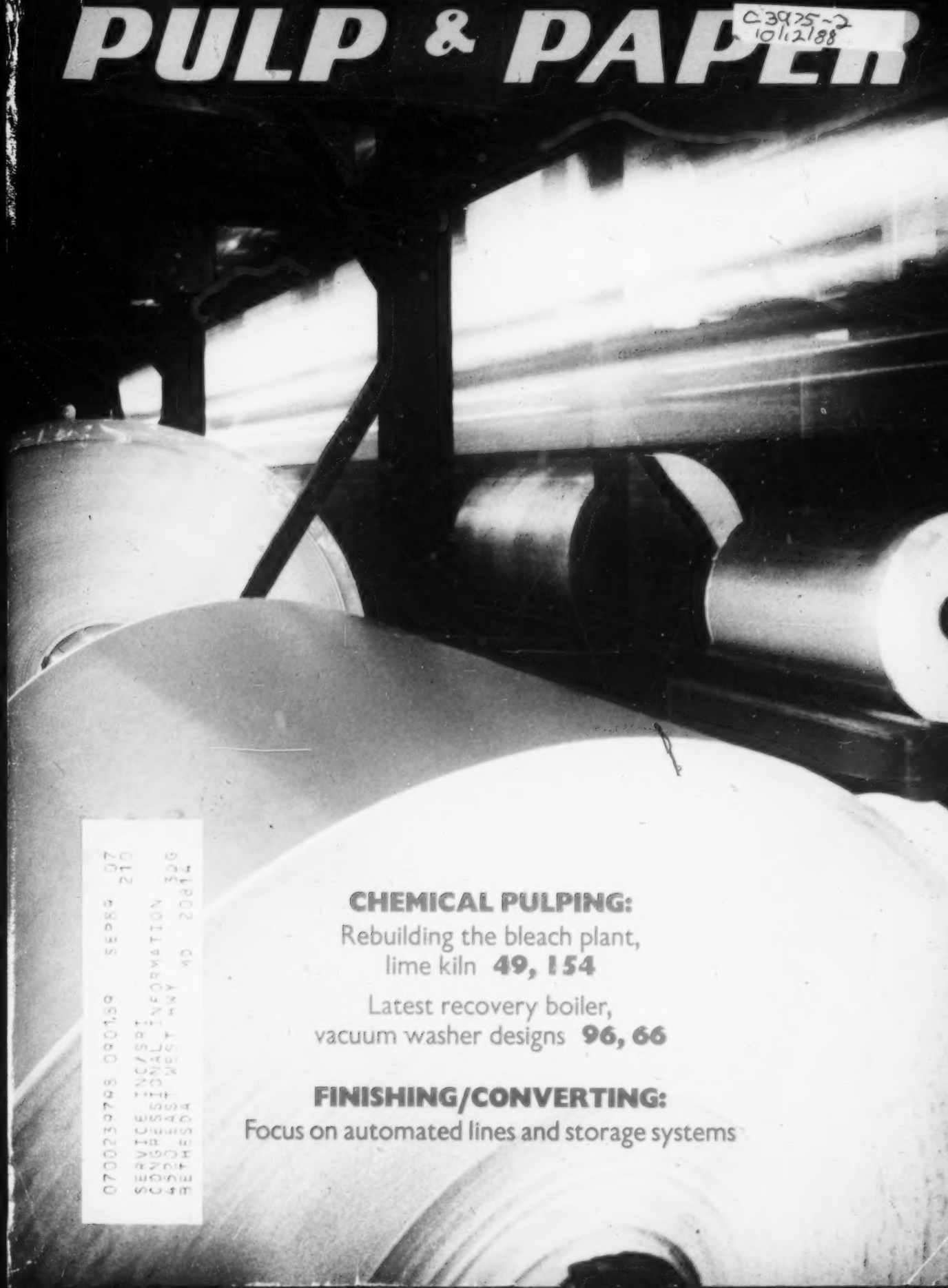
PULP & PAPER

C3975-2
10/12/88



CHEMICAL PULPING:
Rebuilding the bleach plant, lime kiln **49, 154**

Latest recovery boiler, vacuum washer designs **96, 66**

FINISHING/CONVERTING:
Focus on automated lines and storage systems

07002397 08 0901.50 SEP89 07
210
SCIENCE INC/SPI
SERVICES INFORMATION
SCIENCE PROJECT MAY 326
SERVICES 10 20814

Volume 62
Number 10

OCTOBER

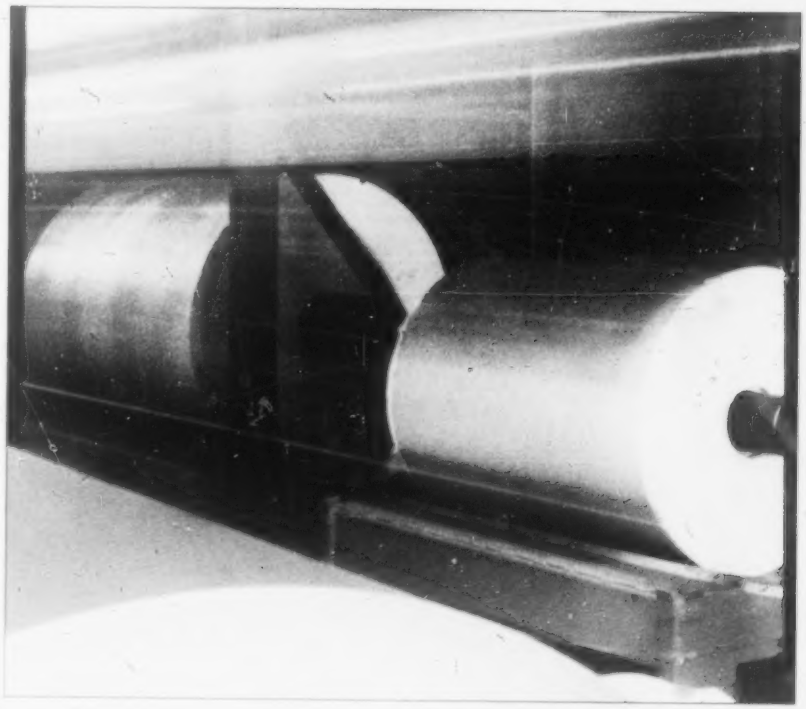
FOCUS: CHEMICAL PULPING

Upgrading bleach plants 49
Evaluation of factors such as pulp quality and grade, energy efficiency, and environmental constraints is necessary prior to any modernization

Pulp washer performance 66
Vacuum washers are reliable and efficient when part of a properly designed system, but many operate at less than acceptable performance

Recovery boiler innovations 96
Many new product innovations to improve safety and uptime have come in the past five years and must be considered by boiler purchasers

Upgrading older lime kilns 154
Many techniques can improve energy efficiency with short paybacks; added benefits include increased production and reduced maintenance costs



FOCUS: FINISHING/ CONVERTING

State-of-the-art equipment 74
German papermaker Haindl Papier expands service to lightweight coated market through strategic grade production, finishing, and delivery

Sheeter ups output 100
Clampitt Paper's new sheeter has increased speed by over 30% (average running speed is now 450 to 550 fpm), also boosting turnaround time

Automatic roll storage 113
Automated roll storage and retrieval system has helped Appleton Papers to better utilize warehouse space in its paper coating and finishing plant

Modernized finishing area 139
Great Northern Paper mill in East Millinocket, Maine, used several technologies to achieve goals of increased quality, reduced unit cost

THE COVER

This issue's focus on Finishing/ Converting includes a detailed feature on Appleton Papers' fully automatic roll storage and retrieval system at Appleton, Wis. See story on p. 113. (Photo courtesy of Jervis B. Webb Co.)

OTHER FEATURES

MANAGEMENT

Macon Kraft upgrade 63
Pratt Group plans $20-million upgrade and expansion for Macon Kraft, the linerboard mill it bought last year, to improve quality and add capacity

Printing/writing outlook 76
U.S. printing/writing paper demand is expected to remain in balance for the next several years, despite predictions of a recession for late 1989 or 1990

PROCESS AUTOMATION

Sheet break detector 110
Champion International's Sartell, Minn., mill has found a fiber-optic sheet break detector that withstands heat and dirt in dryer sections

EXPANSION/MODERNIZATION

Coater section rebuild 129
Gulf States Paper replaced an existing coating station with three at its Demopolis, Ala., mill, allowing two-side application and higher quality

PAPERMAKING

Ventilation systems 132
Experience pays in avoiding not-so-obvious pitfalls in the machine room ventilation system design; attention to all aspects of air movement is critical

PULP&PAPER

EDITORIAL STAFF

Editor in Chief Ken L. Patrick AT
Executive Editor Kenneth E. Smith AT
Executive News Editor Willard E. Mies SF
Consulting Editor John C.W. Evans NY
Senior News Editor Debra A. Garcia SF
Technical Editor Michael J. Ducey SF
Technical Editor Andy Harrison CH
News Editor Carl P. Espe SF
News Editor Rob Galin SF
News Editor Regina M. McGrath SF
News Editor Noel DeKing NY
Projects Editor Kelly H. Ferguson AT
Departments Editor Beverlee Davis SF
International Editors Peter Sutton BR
John Pearson BR
Hugh O'Brian BR

Managing Editor Paula J. Irons SF
Assistant Managing Editor Margaret L. Brown SF
Art Editor Nancy E. Bentley SF
Copy/Production Editor Marta L. Dils SF
Technical Artist Pamela S. Patrusky SF

Office locations

AT = Atlanta: 2700 Cumberland Parkway N.W., Suite 530, Atlanta, Ga. 30339; (404) 432-3186
CH = Chicago: 35 E. Wacker Dr., Chicago, Ill. 60601; (312) 372-6238
SF = San Francisco: 500 Howard St., San Francisco, Calif. 94105; (415) 397-1881; Telex 278273
NY = New York: 370 Lexington Ave., New York, N.Y. 10017; (212) 683-9294; Telex 220442
BR = Brussels: Chaussée de Charleroi 123a, Boite 5, B-1060, Brussels, Belgium; Telex 846-24672

PUBLISHING HEADQUARTERS
San Francisco, California

Publishing Director Leigh M. Freeman
Group Publisher Leonard E. Haas
Director of Production Andrew A. Mickus
Director of Circulation Wini D. Ragus
Ad Production Coordinator Gary A. Fong
Marketing Coordinator Dana Baker
Clerical Assistant Carol L. Parkinson

Sales and business offices are listed on Advertisers' Index page

MILLER FREEMAN PUBLICATIONS

Chairman of the Board ..... Lord David R. Stevens
President ..... Marshall W. Freeman
Vice President ..... Charles C. Baake
Vice President ..... Leigh M. Freeman
Vice President ..... Leonard E. Haas
Vice President ..... Barbara M. Hampson
Vice President ..... Thomas L. Kemp
Vice President ..... Wini D. Ragus
Corporate Financial Manager ..... Charles H. Benz
Secretary/Treasurer ..... Miller Freeman III
Assistant Treasurer ..... Douglas M. Denny

PULP & PAPER (ISSN 0033-4081), with which is combined *Paper Mill News*, *Paper Trade Journal* and *Pacific Pulp & Paper*, is published monthly except November when semimonthly by MILLER FREEMAN PUBLICATIONS, 500 Howard St., San Francisco, Calif. 94105. Second class postage paid at San Francisco and at additional mailing office.
POSTMASTER: Please send addresses changes to PULP & PAPER, 500 Howard St., San Francisco, Calif. 94105.

© Copyright 1988 by Miller Freeman Publications Inc. All rights reserved.

ABP VBPA

Subscriptions & Address Change: Sent without charge in the U.S.A. & Canada (upon written request) to individuals in pulp, paper, and board manufacturing firms and paper converting firms. To all others there is a subscription charge of $60.00 a year in the U.S. All subscriptions to other countries: $80.00 a year, except Europe and Mediterranean, $90.00 (air service included). Single copy, $6.00, except Buyers Guide, $30.00. Photocopies of articles and complete microform volumes available through University Microfilms International, 300 N. Zeeb Rd., Ann Arbor, Mich. 48106.

Requests, subscription orders, and address changes must show name and position or job of individual, name and location of mill, plant or office where employed, and exact business or product produced at this location.

Send subscription correspondence to:
Circulation Department, PULP & PAPER,
500 Howard St., San Francisco, Calif. 94105.
For address change, include label from recent issue.

OCTOBER

COLUMNS

From the Editors 7
by Regina McGrath
Following the story line and the bottom line

Chemical Report 39
by Michael Ducey
Traditional Na/S balances: battleground for commodity suppliers

Quality Report 161
by Lars Ingman
Formation: will we ever get it right?

Career Development 165
by Roberta Bluestein
Getting the most from your training dollar

Comment 234
by Ross Hoyle
Bigger is better is balderdash

DEPARTMENTS

Conference Calendar 41
News of People 167
Product Showcase 183
New Products 183
Product Review 199
Literature 201
Bookshelf 209
Supplier News 211

SERVICES

Reader Service Index 175
Reader Service Review 176
Reader Service Card 177
Professional Service Directory 218
Classified Advertising 220
Advertisers Index 232

NEWS

Month in Statistics 9
U.S. paper and paperboard production data for July

Market Report 11
NBSK prices rising in fourth quarter
Europeans raise kraft liner prices
Major producers lift offset $50/ton
Mills lift forms, offset lists $50/ton

Grade Profile 13
Paper-grade chemical market pulp: Pulp bull market may begin to slow in 1989

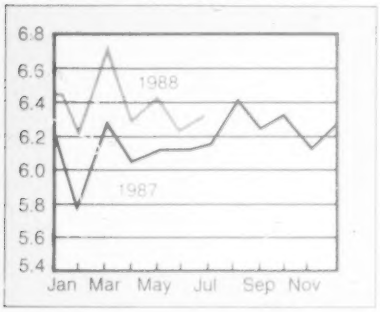
NEWS SCAN

WTD to build market pulp mill 21
Donohue, Rexfor build pulp mill 21
Korean to build $66-million mill 25
Longview Fibre to buy more OCC 25

FSC building recycled tissue mill 25
BCFP and Crown Forest merge 27
Mead to raise Stevenson capacity 27
Willamette to idle machine 27
Newark buys mill from Federal 29
Pulp capacity to grow 2.1% 29
Weyco Canada starts up machine 31
Kanzaki to triple output 33
Du Pont expands insulating paper 33
UPIU alleges IP is losing money 33
EPA issues interim dioxin strategy 33
Kymmene debuts new process 35
James River to enter wipes market 35

International News 37
Daishowa completes Reed acquisition
Additional newsprint to hit France
China plans greenfield mill
Fletcher Challenge sells Winstone
More medium coming on in Spain
Sweden's market pulp output rises
Kanzaki to install free-sheet unit

U.S. paper and board production



U.S. paper and paperboard production totaled 6.3 million tons in July, up just 0.8% over July 1987, according to the American Paper Institute. The relatively small year-over-year increase reflects the flat trend of growth during 1988. Because production was at record high levels when the growth trend flattened out, however, the trend rate is still up 3.8% on a seasonally adjusted, annualized basis. The rate of paper production was 38.4 million tpy through July, up 4.7% from 1987, while paperboard producers kept up a 38.1 million tpy pace, a gain of 3.0%.

Among major grades, printing and writing paper output was up 7.0% through July. Recycled paperboard was strongest among the paperboard grades, up 6.0% through the first seven months. Production of containerboard for domestic use rose 4.2%. Commerce Dept. trade data show exports of unbleached kraft linerboard down 4.2% in the first half, but market pulp exports jumped 14.2% over the same period.

Canadian newsprint shipments totaled 794,000 metric tons in July, up 1.9% from July 1987. Woodpulp exports climbed 8.4% to 706,000 tons. July operating rates were 96% for newsprint and 102% for market pulp. ■

	Latest month (000 short tons)	% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION [1]				
Newsprint	July	481	-4.2	5,947	3.2
Uncoated groundwood (s)	July	142	7.6	1,576	3.5
Coated paper (s)	July	592	1.4	7,374	10.3
Uncoated free sheet (s)	July	928	0.0	11,338	5.6
Other printing/writing	July	121	9.0	1,518	12.1
Total packaging and other paper (s)	July	404	3.1	5,161	2.2
Tissue	July	444	2.3	5,410	3.5
Total paper	**July**	**3,110**	**0.9**	**38,323**	**5.2**
Unbleached kraft paperboard	July	1,620	-1.8	19,358	4.0
Semichemical medium	July	480	1.9	5,668	1.6
Bleached paperboard	July	389	4.6	4,478	0.6
Recycled paperboard	July	691	4.1	8,872	6.0
Total paperboard	**July**	**3,178**	**0.7**	**38,397**	**3.5**
Total U.S. paper and paperboard output	**July**	**6,288**	**0.8**	**76,720**	**4.3**
PULP, WASTEPAPER & FIBER [2]				
TAPPI U.S. woodpulp production	June	4,964	0.1	60,744	3.2
Market pulp production	June	700	1.2	8,304	5.4
Wastepaper consumption at paper/board mills	June	1,563	6.0	18,918	4.9
Pulpwood consumption (cords)	June	7,689	0.4	96,382	2.3
CONVERTED PRODUCTS STATISTICS [3]				
Corrugated box shipments (billion ft²)	July	24.470	3.7	178.192	3.2
Containerboard inventories at U.S. box plants and mills	July 9	2,615	3.6		
INTERNATIONAL TRADE [2]				
U.S. paper imports (including products)	June	1,051	-0.6	12,856	3.6
Imports of Canadian newsprint	June	829	11.9	10,176	1.3
U.S. paper exports (including products)	June	474	7.3	5,810	13.2
Exports of unbleached kraft linerboard	June	170	-20.6	2,159	-4.2
Exports of woodpulp	June	497	9.2	5,416	14.2
Nonscan pulp inventories [4]	July 31	809	-16.7		
Nonscan pulp operating rates [4]	July	103%	96%	90%	99%
CANADIAN STATISTICS [5] *(reported in metric tons)*				
Total newsprint shipments	July	794	1.9	5,668	0.9
Operating rates	July	96%	92%	99%	98%
Inventories held by U.S. consumers	July 31	1,567	6.8		
Other paper/board shipments	July	532	3.9	3,902	6.1
Woodpulp shipments (export only)	July	706	8.3	4,722	2.0
Operating rates	July	102%	101%	97%	97%

1. American Paper Institute. 2. API, Bureau of Census, American Paperboard Assn. 3. Fibre Box Assn., Paperboard Packaging Council. 4. North American/Scandinavian paper-grade market pulp. 5. Canadian Pulp & Paper Assn. 6. Not annualized. (s) = Shipments.

Paper-grade chemical market pulp: Pulp bull market may begin to slow in 1989

Grade structure: Chemical paper-grade market pulp is sold in the open market and does not include captive pulp used onsite or shipped to affiliated mills within North America. Pulp is divided into grades based on whether it is made from softwood or hardwood fiber, whether it is produced by the sulfate (kraft) or sulfite pulping process, and whether it is bleached, semibleached, or unbleached.

Northern bleached softwood kraft (NBSK) is the premium pulp grade because of its long fiber length and strength. U.S. chemical paper pulp statistics include about 1.7 million tons of fluff pulp production (including exports) used in diapers and other absorbent hygiene products. Dissolving and mechanical pulp grades are excluded from the statistics.

Production/capacity: The strong pulp market has continued in 1988, with Canadian and U.S. chemical paper-grade market pulp mills expected to run close to 100% of capacity for the second year in a row. The market for softwood remains tight despite the recent peaceful settlement of British Columbia labor negotiations, while hardwood pulp is only somewhat more available.

Latest pulp inventory statistics suggest that the bull market in pulp still has a ways to go. North American and Nordic producer pulp inventories dropped to another low in the current cycle of 670,000 metric tons at the end of June.

For all of 1988, U.S. production of chemical paper-grade market pulp is expected to be up 4% this year, resulting in an operating rate of more than 101%. Canadian production is projected to be up about 1% in 1988, resulting in operating rates of about 98%. (The operating rate figures are based on 1987 capacity survey numbers, which probably will be revised upward for both countries.)

Future outlook: The pulp market is expected to remain relatively strong through 1989, although it could weaken in the second half if the U.S. economy begins to slow significantly next year.

Any weakness would probably first appear in hardwood pulp, which has been in somewhat more available supply and will be facing the most competition from 600,000 tpy of new bleached chemi-thermomechanical market pulp (BCTMP) capacity coming onstream in Canada. Normally, pulp market downturns lag turning points in the economy by one or two years, but this time the decline in the pulp market could come more quickly because of the lofty level of pulp prices and high profit margins of North American producers.

Nevertheless, limited capacity growth should help restrain the severity of any downturn. U.S. chemical paper-grade market pulp capacity is expected to rise only 0.8% in 1989 and remain relatively flat in 1990. Canadian capacity is expected to decline 1% in 1989. Even with the inclusion of the new BCTMP capacity, Canadian paper market pulp capacity is expected to rise only 1.9% in 1989.

World market pulp capacity growth will not increase much until the early 1990s, when at least 1.8 million tons of new market pulp capacity will be starting up in Latin America.

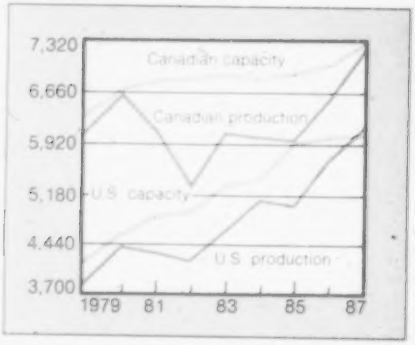
Pricing: North American pulp export prices in Europe have risen for 11 consecutive quarters, with the price of benchmark NBSK hitting $760/metric ton in the third quarter of 1988—nearly double its level at the end of 1985. The pattern will probably be broken in the fourth quarter of 1988 due to the recent strengthening of the dollar, which during the summer created a roughly $50/ton gap between North American dollar pulp prices and Nordic local currency prices in Europe.

As a result, North American producers will probably leave their export prices unchanged while Nordic producers close the gap with dollar pulp prices. Meanwhile, North American producers may try to raise the domestic price of NBSK by $25/ton, bringing the U.S. level up to the export market price.

Year-end U.S. market pulp prices ($/metric ton delivered) for NBSK: 1983, $450; 1984, $510; 1985, $390; 1986, $480; 1987, $520; 1987, $610.

For additional details on market pulp demand, supply, and price trends see Pulp & Paper's just-released 1988 FactBook.

SUPPLY/DEMAND (000 tons)



FORECAST (000 tons)

U.S.	1986	1987	1988e
Production	5,729	6,186	6,433
Capacity	6,015	6,147	6,347
Utilization rate	95.0	101.0	101.4
Imports	2,568	2,680	2,740
Exports	3,404	3,650	3,750
Apparent U.S. consumption	4,893	5,216	5,355
Canada			
Production	6,597	7,203	7,275
Capacity	7,151	7265	7330
Utilization rate	92.0	99.1	99.3

e = Estimate

1. Based on 1987 American Paper Institute and Canadian Pulp & Paper Assn. capacity surveys

TOP U.S. PRODUCERS (000 tpy)

	Annual capacity	Market share (%)
1. Weyerhaeuser	1,245	9.1
2. CP	925	6.8
3. IP	800	5.8
4. Georgia-Pacific	650	4.8
5. Canton	635	4.6
6. P&W	615	4.5
7. Repap	510	3.7
8. ON Nekoosa	490	3.6
9. MacMillan	481	3.5
10. Fletcher CC	466	3.4

Capacity share of top five companies
31.1%

Capacity share of top ten companies
49.8%

Total North American capacity (1988)
13.677 million metric tons

1. Bleached softwood kraft. 2. Bleached hardwood kraft. 3. Semibleached softwood kraft. 4. Unbleached softwood kraft. 5. Bleached sulfite. 6. Fluff pulp. 7. Reflects consolidation of Great Lakes Forest Products (595,000 tpy) and CIP (330,000) into Canadian Pacific Forest Products. 8. Reflects 100% of Crown Forest (190,000 tpy) and 69% of British Columbia Forest Products (400,000)

Newark Group buys recycled board mill from Federal

The Newark Group has acquired Federal Paper Board Co.'s 160-tpd recycled boxboard mill in Los Angeles, Calif., for an undisclosed amount. The Newark Group is a privately owned holding company that currently operates nine recycled paperboard mills throughout the U.S., a number of converting subsidiaries, and a wastepaper trading company.

Federal also operates a 24-MW cogeneration facility adjacent to the Los Angeles mill, which it intends to sell to a separate buyer. FPB Cogen Inc. is a Federal subsidiary that supplies steam and electric power to the mill and sells excess electricity to the local public utility under a long-term contract. In 1987, the cogeneration plant made operating profits of about $2.0 million on sales of $9.0 million.

The acquisition of the Los Angeles mill will raise Newark's total recycled paperboard output to approximately 735,000 tpy. The Los Angeles mill will become Newark's tenth paperboard mill and will operate as Newark Pacific Paperboard Corp. Its clay-coated folding carton grades will be sold to independent converters in southern California. When Federal owned the mill, most of its production was converted at its own Los Angeles folding carton plant, but that facility was closed last year when Federal announced its intent to sell the mill.

• In the meantime, Newark Boxboard Co. has signed a long-term contract to buy steam from a new cogeneration plant being built by O'Brien Energy Systems. The 52-MW, $52-million plant, which will be owned and operated by O'Brien on land leased from the Newark, N.J., mill, is slated to start up in April 1990. Newark Boxboard, a subsidiary of Newark Group, has capacity for 130 tpd of bending chipboard and other kinds of board. A mill spokesman said that the arrangement will permit Newark to idle its steam boiler and will provide considerable cost savings as well as permit possible future expansion. ■

Inland Container to install first 1,000-fpm corrugator

Inland Container Corp. plans to construct a 30,000-ft² addition to its box plant in Biglerville, Pa., and it will install a new high-speed corrugator. The computer-controlled, 98-in. Mitsubishi corrugator is capable of running at speeds of up to 1,000 fpm. It will be the first 1,000-fpm corrugator installed in the U.S.—a similar machine is in operation in Europe, the company said.

The corrugator should have an ultimate capacity of about 100,000 tpy and produce a more uniform sheet. The plant's existing corrugator will be moved to the company's new plant in the Rio Grande Valley of Texas.

• Union Camp Corp. has completed a $7-million, year-long expansion and modernization of its Denver, Colo., container plant. A new 87-in. Mitsubishi corrugator was installed, which will increase the plant's capacity by about 40%—from approximately six tons/hour to eight to nine tons/hour. Also included were a new tray press, an upgraded diecutter, a new boiler, a starch system, and electrical service. The plant was expanded by 30,000 ft², mostly for storage of roll stock and finished goods. ■

Lin Pac opens its first West Coast plant

Lin Pac Inc. recently opened a new corrugated sheet feeder plant in City of Industry, Calif.—its first operation on the West Coast. The plant has an 87-in. corrugator and is housed in a 126,000-ft² building. "Our intention is to sell sheets to independent corrugated converters," said general manager Jack O'Connor. The Los Angeles-area plant started up May 31 and recently added a second shift.

Lin Pac now has a total of four corrugated sheet feeder plants in the U.S., located in Atlanta, Ga.; Fort Worth, Texas; and Greensboro, N.C. The company recently sold its Philadelphia, Pa., plant to the Pratt Group, which owns Macon Kraft Inc. ■

FORECAST

Pulp capacity to grow 2.1% through 1992

Total worldwide capacity for paper-grade woodpulp is expected to grow 2.1% annually from 1987 to 1992, reaching a total of 173.2 million metric tons. Total paper and paperboard capacity is expected to increase by 2.3% during the period, reaching 260.8 million tons, according to the Food & Agriculture Organization's (FAO) latest Pulp & Paper Capacities survey. Both of these growth rates are higher than those forecast in FAO's 1986-91 study, in which woodpulp capacity was forecast to increase 1.4% and paper and board capacity was slated to grow 1.9%.

In 1987, capacity for paper-grade woodpulp was estimated at 156.5 million tons, an average annual rise of 1.8% from 1982. Capacity is expected to increase by 16.7 million tons to 173.2 million tons by 1992—a 2.1% annual rise. Capacity for paper and board in 1987 was 233.1 million tons, an average annual increase of 2.8% from 1982. By 1992, capacity is expected to rise 27.7 million tons to 260.9 million tons, a 2.3% average annual increase compared with a 2.8% increase from 1982 to 1987.

The fastest growth in paper and paperboard capacity over the next five years is forecast for the developing economies in Africa, Latin America, and Asia, which will see a growth of 3.6% annually. This is considerably lower than the 5.2% growth during the 1982-87 period. The developed-countries segment follows with a projected annual increase of 2.2%—a slight drop from the 2.3% rise for the 1982-87 period.

The developed countries will account for about 76.4% of total paper and paperboard capacity in 1992. Developing countries will have about a 10.7% share in 1992—almost unchanged from the FAO's previous survey (*P&P*, Feb. 1988, p. 33). Centrally planned economies will account for about 12.9%.

Paper grades. The FAO reports that 1987 newsprint capacity of 32.8 million represented a 0.6-million-ton increase from 1986. Capacity for this grade is expected to increase by 3.2%/year to a total of 38.2 million tons by the year 1992.

World capacity for printing/writing grades amounted to 63.5 million tons in 1987, up 3.6 million tons over 1986. World capacity for these grades is expected to grow 3.2%/year, or by 10.8 million tons by 1992.

The "other" paper and board category is 80% packaging paper and board, 10% household and sanitary paper, and 10% other grades. The FAO reports that 1987 world capacity in this category amounted to 136.8 million tons—an increase of 2.9 million tons over 1986. Capacity is expected to grow 1.6%/year, or by 11.5 million tons.

Pulp grades. The current FAO survey shows that the apparent production ratio of pulp to paper is continuing its downward trend, dropping from 73.5% in 1987 to 72.8% by 1991. Worldwide market pulp capacity in 1987 was estimated at 31.6 million tons and is expected to increase to 33.9 million tons by 1989.

Chemical paper-grade woodpulp capacity was about 107.9 million tons in 1987 and is expected to grow 1.8% annually to 117.7 million tons in 1992. Chemical pulp accounted for about 63% of total pulp capacity in 1987, with a slight decrease expected by 1992.

Mechanical pulp capacity will increase 6.1 million tons from 38.7 million in 1987 to 44.8 million tons in 1992. This can be attributed to strong growth in thermomechanical pulp (TMP), which will see an average annual increase of 7.5%. The FAO noted that developed market economies account for 96% of total mechanical pulp output and of that North America will contribute 53%. Mechanical pulp other than TMP is expected to grow by only 129,000 tons, or an annual average increase of 0.1%.

The capacity for dissolving pulp was 5.9 million tons in 1987 and was projected to reach 6.3 million tons in 1992. The capacity for other fiber pulp was 14.8 million tons in 1987, and this is expected to reach 16.8 million tons by 1992. Developing countries account for about 87% of this and will use 51% of the total in their paper furnish. People's Rep. China, with 7 million tons, accounts for 54% of world capacity, while India, with 2 million tons, accounts for 14%. ■

FAO forecasts for world pulp and paper capacity.

World woodpulp capacity, 1987-92

	Capacity (000 metric tons)		Annual average increase	
	1987	1992	1982-87	1987-92
World total	156,469	173,230	1.8%	2.1%
Developed economies	127,493	139,834	1.5	1.9
North America	78,173	84,429	1.5	1.6
Japan	12,242	13,604	0.1	2.1
Western Europe	33,166	37,604	1.5	2.5
Oceania	2,462	2,749	0.4	2.2
Others	1,450	1,450	12.6	0
Developing economies	9,856	13,745	4.6	6.9
Africa	884	1,034	8.2	3.2
Latin America	6,686	9,964	3.6	8.3
Asia[1]	2,286	2,747	6.4	3.7
Centrally planned economies	19,120	19,651	3.0	0.5
Asia	2,657	3,166	18.3	3.6
Eastern Europe	4,413	4,435	1.4	0.1
U.S.S.R.	12,050	12,050	1.4	0

World paper and paperboard capacity, 1987-92

	Capacity (000 metric tons)		Annual average increase	
	1987	1992	1982-87	1987-92
World total	233,114	260,854	2.8%	2.3%
Developed economies	178,503	199,289	2.3	2.2
North America	88,358	96,856	1.8	1.9
Japan	25,286	28,473	2.1	2.4
Western Europe	60,266	68,879	3.0	2.7
Oceania	2,565	3,010	0.3	3.3
Others	2,028	2,071	5.4	0.4
Developing economies	23,379	27,864	5.2	3.6
Africa	1,093	1,270	7.7	3.0
Latin America	12,705	14,767	4.3	3.1
Asia	9,581	11,827	6.1	4.3
Centrally planned economies	31,232	33,701	4.4	1.5
Asia	10,512	12,532	12.9	3.6
Eastern Europe	6,720	7,169	1.0	1.3
U.S.S.R.	14,000	14,000	1.5	0

1. Figures for Asia are divided by type of economy.
Source: Food & Agriculture Organization of the U.N.

FINE PAPERS

Weyco Canada starts up machine in Prince Albert

Weyerhaeuser Canada Ltd. started up its new 210,000-metric-tpy uncoated free-sheet machine in Prince Albert, Sask., on Aug. 29. The machine produced about 100 tons of alkaline paper on its first day. Some 95% of that paper was salable and two reels were sold to a customer in Pennsylvania, a spokesman said.

The C$250-million greenfield mill adjacent to an existing market pulp mill will produce communication papers, such as business forms stock, copy paper, and computer stock, according to Joe Ralko, public affairs manager for Weyerhaeuser Canada's Saskatchewan Div.

Weyerhaeuser purchased the pulp mill in 1986 and agreed to build the paper mill within three years, or no later than December 1989. Later, construction plans called for startup in early 1989, but the company beat that schedule because "there were no labor problems," Ralko said. He said the project was the largest open merit shop (nonunion) of any industry in Canada. The main contractor, Saskatoon Construction, a subsidiary of BE&K, was not unionized and unions failed to gain certification at the subcontractors, Ralko said.

Valmet-Dominion provided a 318-in.-trim paper machine. Process control systems were from Impact Systems and AccuRay. H.A. Simons was

Traditional Na/S balance: battleground for commodity suppliers

COOKING. The continued climb of caustic soda prices has begun to influence the way mills make up liquor for kraft pulping. Last year's reported 30% rise in caustic price has been repeated—cost for all grades of caustic breached the $200/ton level. Mills are currently reevaluating the conversion to soda ash, and some mills have already signed purchase orders for carbonate. On the sulfur side, demand for emulsified products is still growing feverishly. But sulfur prices to these suppliers are rising too, and forecasts call for an increase in demand for outside saltcake due to its more attractive price and availability.

Production of pulp through the kraft cooking technique surged upward again in 1987. In Canada, all kraft production rose 6.2%, but 1988 will achieve less than half that gain. Capacity for kraft pulp in Canada will climb higher due to a spate of expansions, including a new pulp mill at Peace River, Alta. (Daishowa Canada Corp.), a new line at Howe Sound, B.C. (joint Oji Paper Co. Ltd. and Canfor Corp.), continuation of the project at Windsor, Que. (Domtar Inc.), upgrades at Crofton, B.C. (British Columbia Forest Products Ltd.) and Hinton, Alta. (Weldwood Ltd.), and several others accounting for C$2 billion in expenditures through 1992.

In the U.S., sulfate production grew about 5% in 1987, and 1988 shows signs of a still bullish 3.5% gain. U.S. producers also acknowledge extended healthy demand. New kraft pulping lines have been announced for Columbus, Miss. (Weyerhaeuser Paper Co.), Samoa, Calif. (Louisiana-Pacific Corp.), Calhoun, Tenn. (Bowater Southern Paper Co.), Bennettsville, S.C. (Willamette Industries Inc.), and most recently at Port Westward, Ore. (WTD Industries Inc.). More expansions are completed or under way at another dozen mills.

The high operating rates of the existing kraft pulp mills ensure some stability to the present suppliers. New or substitute suppliers are scrambling for new territory now, anticipating the economic cycle to reverse, perhaps late in 1989. Saltcake suppliers believe that discounting of their products will soon be curtailed and that the list price will firm. Tightening of sulfur supply, high caustic prices, and high-capacity utilization of mills are the reasons given. The economic realities behind soda ash conversion from caustic are slowly being absorbed. Transportation rates from Green River, Wyo., and the volume purchase agreements stipulated by contracts had been the driving forces for mill conversions. The widening price differential and tight long-term caustic supply outlook are appealing to every kraft mill site. Evidence is also seen from supplier movement.

General Chemical is seeking a patent for its conversion process known as GCH-4, and a new soda ash producer has emerged in Cortland, N.Y. (Natrium). This new supplier is playing the same regional game that Riverside Products (Cartersville, Ga.) played in 1984. The bigger players are indicating that they support these developments, hoping that converters will bring them in as major suppliers and retain the local sources only as substitute or complementary suppliers. In summary, the soda ash producers are running close to full, and supply is tightening rapidly. List prices are firm and may go higher. Reports indicate that 10% to 15% of kraft mills switched during 1988, while many others retained suppliers for quotes.

New pulping technologies are also receiving commercial attention. Chlorine dioxide generators that produce little or no salt are being installed, helping site-ready products such as emulsified sulfur into makeup loops. Extended delignification has been applied with success at more new or expanded lines. Oxygen delignification seems to be popular too, as mills seek to bleach less and apply more front-end pulping. Ethanol pulping is being tried at Repap Enterprises Corp. Inc., and a new line using the S-pulping technique has been announced in Saskatchewan. The former mentioned technologies are well accepted but will not play a major role in shifting makeup chemicals. The latter two may have far-reaching effects on pulping, should they be commercially successful.

RECOVERY. The U.S. Bureau of Mines reports that lime production increased 8% over 1987, with big gains registered by the chemical, industrial, and refractory segments. In the kraft pulping industry, strong production helped lime shipments increase 5%. Lime producers are not very interested in this segment of the industry, as new kiln, slaker, and computer-control equipment have brought lime makeup requirements steadily downward on a production (lb/ton) basis. The new area for these suppliers is the advent of onsite calcium carbonate generators, which accept lime products and process them into a variety of components for filling and coating paper.

Michael Ducey

Shifts in chemicals cause upswing for kraft pulping suppliers.

Chemical	Pulp and paper consumption 1987 (short tons)	% change 1988	Price mid-1988 ($/ton)	% change 1989
Sodium sulfate	527,500	5.5	65	5
Caustic	2,225,000	7.0	225-275	10
Soda ash	900,000[1]	12.0	85	0
Lime	1,254,000	4.5	40-50	0

1. Indicates revised outlook from September column.

OUTLOOK FOR FINE PAPER, LINERBOARD TO REMAIN HEALTHY THROUGH 1992

Industry executives see a bright future for uncoated free-sheet and kraft linerboard despite predictions of a recession by 1990

P&P STAFF REPORT

For the next several years, U.S. printing/writing paper demand is expected to remain in balance, even with a slight recession predicted for late 1989 or 1990. But operating rates in Europe are expected to decline sharply as expansion outstrips healthy demand growth and exports remain flat. In contrast, to sustain a 97% operating rate from 1989 to 1991, U.S. containerboard mills will have to lift production by an average of only 1.86%/year from this year's level. These were some of the conclusions reached at last summer's Financial Analysts Federation meeting in Portland, Ore.

The strongest printing/writing grade in the U.S. in terms of capacity utilization will be uncoated free-sheet, while newsprint will be the weakest, according to Michael P. Corey, vice president corporate analysis at Champion International Corp. John C. Veness, manager-market research, English China Clays, said that operating rates for coated grades in Europe could drop to the low-80% range. U.S. uncoated free-sheet mills will average a 96% operating rate in 1992, up 1% from 1987, according to Corey. This is based on demand growth of 3.05%/year, compared with capacity additions at 2.9%, Corey said. Leading demand growth in this grade are office reprographics and forms bond papers, which Corey said are fueled by continued proliferation of office copying systems and personal computers. Reprographics will advance about 6%, while forms will follow at 5%.

Offset printing also will continue to grow, but demand in envelope papers probably will not grow as fast due to the substitution of electronics for some of its transactional applications. Growth in envelopes will be about the same as real gross national product (GNP), or about 2%/year.

NEWSPRINT RATES TO DIVE. Newsprint will drop to about 90% in 1992 from its 1987 rate of 95% utilization. In fact, Corey predicted that capacity will advance almost twice as fast as demand over the next few years. Demand growth is expected to be 3.4%/year through 1992, but shipments probably will rise only 1.9%.

The overwhelming number of new machines may cause some companies thinking of adding new capacity to abandon, or at least postpone, those additions, Corey said. Demand is based upon circulation growth and advertising pages. Circulation has been moderate in recent years and will likely continue at that pace. Sales of ad space probably will mirror GNP, according to Corey. In addition, rising prices for newsprint may renew publishers' interest in paper conservation, thereby moderating demand increases, he said.

COATED PAPERS IN BALANCE. The demand for coated groundwood papers will be stronger than the supply through 1992, with shipments growing about 4.2%/year compared with 3.9% annual capacity growth. This will put mill operating rates at 93% in 1992, up from 92% in 1987. Coated free-sheet grades operating rates will decline slightly as capacity rises 5.1% compared with new demand at 4.5%. This should lead to utilization of 93% in 1992, compared with 95% last year, Corey said.

The strongest growth for coated papers will lie with such end uses as newspaper advertising inserts, catalogs, and other commercial printing. Magazines also may do relatively well. Corey suggested that all of these segments will grow by at least 4%/year through 1992.

Uncoated groundwood paper operating rates are expected to drop slightly from 95% in 1987 to 94% in 1992. Corey's estimates are based on annual demand growth of 2.9% and a 3.3%/year capacity advance. Groundwood papers will do best in what are already their largest end uses. Those rising 4.0%/year or better through 1992 will be periodicals other than magazines (Sunday newspaper magazines), commercial printing (inserts and flyers), and business forms. Magazine use of groundwood will advance by just over 1%, as will book publishing, Corey said.

EUROPEAN MARKET NOW STRONG. European mills produced about 18 million metric tons of uncoated free-sheet and uncoated groundwood grades in 1987, according to Veness. Domestic demand amounted to about 15.84 million tons. A little over 2 million tons were exported, about half of which were shipped to the U.S.

Veness estimated that the European printing/writing industry has capacity to produce about 19.1 million tons of paper. Total operating rates for most grades were in the mid- to upper-90% range. He said it was only the uncoated free-sheet and uncoated groundwood that brought the average for all printing/writing grades down to about 94%.

For much of 1987, European suppliers of coated groundwood papers, and to a lesser extent uncoated groundwood papers, were giving such long delivery times that they may as well have been on allocation, Veness said. Uncoated free-sheet papers, however, suffered from an excess of supply due to new capacity that came online in 1986-87 and market growth of less than 2% last year.

TOO MUCH EXPANSION? Veness forecast that about 5 million metric tpy of additional printing/writing capacity will be in place in Europe by 1992. This figure includes both announced and proposed projects—and might be a conservative estimate. About 3.5 million metric tons of this will be coated.

Where will the 5 million metric tons be sold? The major determinant of the printing/writing paper demand hinges on the health of the overall economy, particularly advertising and business papers demand. Veness forecast that European GNP will grow by approximately 2%/year through 1992, which he characterized as a moderate outlook. In tonnage terms, advertising is the more important factor, accounting for between two-thirds and three-quarters of total printing/writing paper consumption (and about 90% of coated paper demand).

Total advertising spending in Europe has exceeded GNP growth for quite a few years, and Veness expects this to continue for some time. Veness pointed out that television in Europe, with the exception of Italy, places fairly strict limits on the amount of commercials it broadcasts. This forces advertisers to turn to print. Through direct mail, print also has the advantage of being able to target specific consumers.

The cloud on the horizon is that when (and if) TV is deregulated, paper demand could be cut, especially in the mass circulation magazines. Veness said a mitigating factor could be that demand for TV advertising is pent up—that is, these ads have not yet been placed anywhere. Also, growth in total advertising spending may increase significantly.

Office papers account for 20% of total printing/writing paper demand and over half of uncoated free-sheet demand. Veness emphasized that the "paperless" office does not appear to be anywhere on the horizon. Rather, he pointed out that office copiers seem to have an insatiable demand for paper. He also expects to see facsimile machines running on standard uncoated stock before the year 2000. On the other hand, modems could cut down the use of printouts from personal computers.

OPERATING RATES TO PLUNGE. Veness expects total European printing/writing paper demand to grow by 2.5 million tons by 1992, bringing total demand to 18.35 million tons—a growth rate of about 3%/year. Coated paper demand is expected to increase by 4.5%. Veness expects uncoated groundwood paper will lose market share to coated groundwood. He characterized these last two grades as "average performers."

European capacity will grow about 4%/year, or 4.9 million tons. With demand expected to grow by only 2.5 million tons, 2.4 million tons of excess paper will be on the market. Traditionally, the gap has been filled by exports. Veness predicted that the net volume of exports in 1992 will be at the same level as in 1987.

This would put the operating rate for European mills in 1992 at 85%—down from 94% in 1987. He noted that mills in Europe still make money in the low-80% range. The operating rate for coated free-sheet would be 82% (down from 94%), with coated groundwood at 80% (down from 97%) and uncoated free-sheet at 88% (down

TABLE 1: **U.S. uncoated free-sheet mills will average a 96% operating rate in 1992, up 1% from 1987.**

Grade	1988-92 Average annual growth rate (%)	1987 shipments (000 tons)	1992 shipments (000 tons)
Total Coated free-sheet	**4.5%**	**3,078**	**3,770**
No. 1	5.0	381	475
No. 2	3.6	303	355
No. 3	5.3	1,060	1,340
No. 4	4.6	760	935
No. 5	5.2	152	190
Coated one side	2.5	422	475
Coated free-sheet capacity	5.1	3,237	4,085
Total coated groundwood	**4.2**	**3,781**	**4,065**
No. 4	4.5	613	750
No. 5	4.0	3,168	3,810
Coated groundwood capacity	3.9	4,132	4,930
Total uncoated free-sheet	**3.0**	**10,982**	**12,655**
Bond/reprographic	4.2	2,858	3,455
Offset	2.5	2,832	3,185
Forms bond	3.6	2,155	2,540
White wove envelope	2.3	916	1,020
Carbonless	5.0	599	750
Tablet	—	425	425
Cover and text	1.8	329	360
Other	2.1	868	920
Free-sheet capacity	2.9	11,520	13,170
Total uncoated groundwood	**3.5**	**1,485**	**1,745**

Source: Champion International Corp.

from 90%). About 75% of the new tonnage coming on-stream will be at integrated mills.

In 1992, tariff barriers in the European Economic Community are slated to be eliminated. Veness expects that this will lead to increased merger activity. He expects mills to emphasize higher-value-added products and to look to export more. He maintained that the European printing/writing industry will remain a healthy, prosperous industry.

U.S. CONTAINERBOARD MILLS SET FOR SUCCESS. To sustain a 97% operating rate from 1989-91, U.S. containerboard mills will have to lift production by an average of only 1.86%/year from this year's level, forecast Michael R. Onustock, vice president of Willamette Industries Inc. Based on American Paper Institute figures, Onustock expects linerboard and medium production to grow by 5.0% from 1987 levels to 26.613 million tons this year. With capacity for 26.912 million tons, mills will be operating at 98.9% of capacity in 1988. The 97% operating rate will be attainable if output grows by 1.4% in both 1989 and 1990 and 2.8% in 1991.

This year, the U.S. will have capacity for 18.487 million tons of unbleached kraft linerboard, 138,000 tons of solid bleached linerboard, and 587,000 tons of recycled linerboard. By 1991, capacity will grow to 19.825 million tons, 146,000 tons, and 746,000 tons, respectively.

Corrugating medium capacity this year will amount to 5.833 million tons of semichemical medium and 1.867 tons of recycled medium. By 1991, U.S. capacity for semichemical will grow by 7.6% to 6.278 million, while recycled medium capacity will grow 6.9% to 1.996 million tons. Onustock expects to see less heavy capital investment in the future. He noted that incremental capacity expansions achieved by installation of a wide-nip press will be the industry's main vehicle for capacity growth. (Reports are that orders for this equipment are so strong that it now requires over two years' lead time to get one installed.)

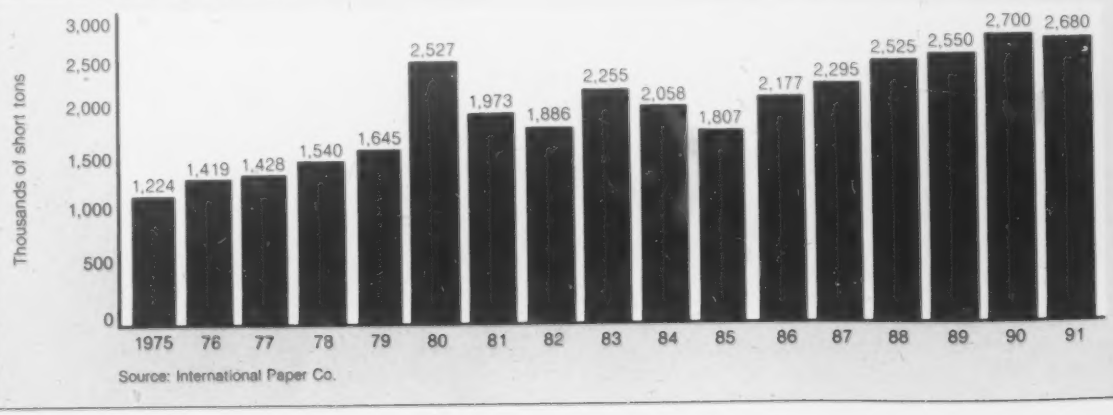
BIG OPPORTUNITIES OFFSHORE. Victor A. Casebolt, senior vice president-kraft paperboard and packaging for International Paper Co., discussed the export market for U.S. paperboard. He estimated that the 1988 global market for containerboard is approximately 67.2 million short tons, about 36% of which will be consumed in the U.S. The Far East will consume 25%, and Western Europe will consume 20%. These three areas account for over four-fifths of total world consumption. Casebolt forecast that by the year 2000, the Far East will surpass the U.S. as the leading consumer of corrugated.

Between now and the year 2000, demand for containerboard will increase by 31 million tons to 98 million tons. Casebolt noted that this is equal to 88 new 1,000-tpd paper machines and observed that the U.S. has brought on only two new containerboard mills in this decade, one of which is IP's Mansfield, La., mill. Outside the U.S., only two world-scale mills were brought on in the 1980s—both in South Africa. Casebolt concluded that demand will have to be satisfied by rebuilding and upgrading mills.

FORECAST OF FUTURE DEMAND. Casebolt expects average annual world growth of 3.2% between now and the end of the century. The leader will be People's Rep. China with about 9% average compound annual growth rate. Latin America and Africa will grow by about 4%; the U.S., Western Europe, and Japan by 2.5%; and Canada by 1.5%. People's Rep. China, which has a scarcity of fiber, represents the number one export opportunity within this time, Casebolt said.

He expects kraft linerboard and semichemical medium world demand to grow by 2.2% and 1.9%, respectively. Demand for recycled linerboard and medium will

FIGURE 1: **Forecast of U.S. linerboard exports, 1975-1991.**



grow by 4.7% and 4.9%/year. Growth of recycled linerboard capacity will be stimulated by the economics of building a recycled mill vs a kraft mill. For a 1,000-tpd recycled mill with an after-tax return of 12%, Casebolt estimated that the capital cost to build a new recycled mill is about $260,000/daily ton and would require a sustained linerboard price of $420 to $450/ton. For a kraft linerboard mill, the cost increases to $350,000/daily ton, requiring a linerboard price of $450 to $480/ton.

Between 1975 and 1987, U.S. kraft linerboard exports increased by 1 million tons, and Casebolt assumes that a similar increase will occur in the next 12 years, bringing U.S. linerboard exports to almost 3.5 million tons by 2000. (Exchange rates could alter this.) Overseas demand in 1988 should increase 10% to just over 2.5 million tons. Casebolt forecast an average growth rate of 2%/year through 1991. The two major exporters of kraft linerboard, the U.S. and Sweden, account for about 64% of world's exports, and this dominance should continue.

LIQUID PACKAGING BOARD DEMAND TO SOAR. Worldwide demand for bleached board was 5.6 million tons in 1987. The U.S. is the major producer, accounting for 78% of the world's 5.9 million tons of capacity. Sweden has 9%, and Finland has 6%.

The U.S. is a net seller of bleached board. It supplies 4.5 million tons, consumes 3.9 million tons, and exports 600,000 tons. Of the latter, 70% is bleached liquid packaging board. U.S. exports of this grade should reach 650,000 tons in 1991, Casebolt projected.

World demand for liquid packaging board was 1.5 million short tons in 1987. This should reach 2.0 million tons in 1995. The U.S. accounts for 37% of world demand of liquid packaging board, or 550,000 tons in 1987, of which 70% was milk cartons and about 23% was juice cartons. Western Europe consumes approximately 25%, while Japan consumes 17%. Demand growth in the U.S. will average 3.0%/year. Growth will be faster in other parts of the world, and world demand growth for liquid packaging board should be 4.3%/year. In the past ten years, the biggest U.S. export markets for liquid packaging board were the Far East, Canada, and Japan. Western Europe has reduced its imports from the U.S. due to competition from the Nordic countries. Japan, Canada, Mexico, Singapore, and Rep. Korea present particularly good export opportunities for the future, Casebolt said.

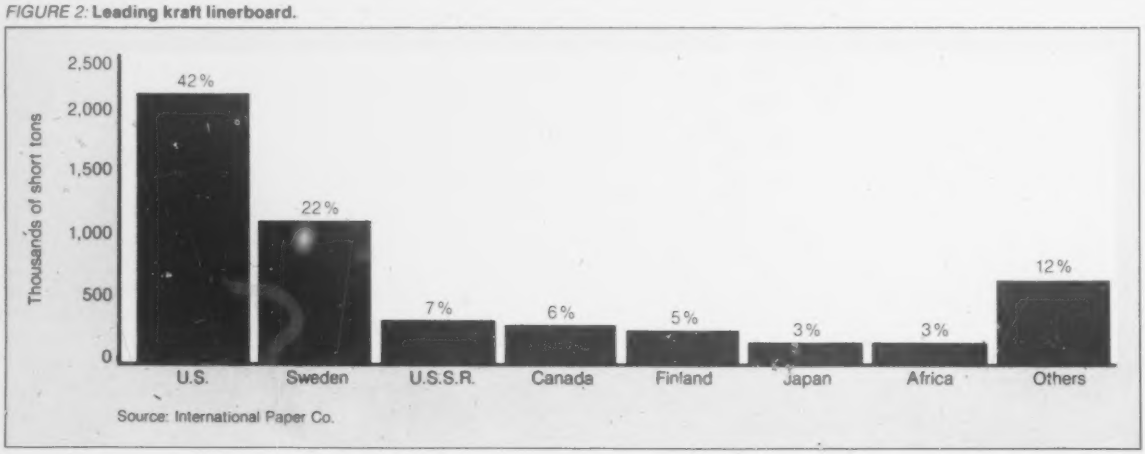
EMPHASIS ON QUALITY. The traditionally commodity-oriented U.S. containerboard/corrugated box industry recently has been placing increased emphasis on the quality and value of its products, according to Frederick V. Ernst, group vice president, Chesapeake Corp.

This change has been brought about by a number of factors. Increased concentration has resulted in a new sense of industry leadership. Also, concern about plastic competition in the packaging field has been growing. Finally, changes in the U.S. distribution system (from rail to truck) and in retail marketing have occurred. As a result of such pressures, the industry has been trying to produce linerboard with greater stacking strength, increased porosity, and more graphic appeal, he noted.

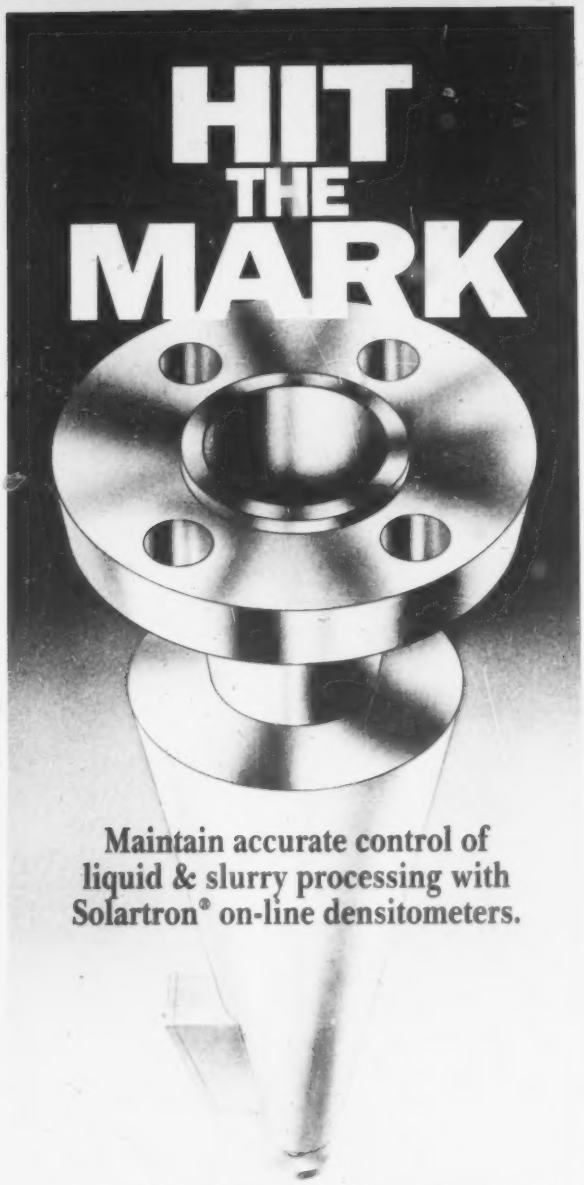
Chesapeake's new No. 3 Tri-Kraft machine is a response to a number of these requirements, particularly for linerboard with a low-cost white printing surface. The machine serves the market for point-of-purchase display, where packaging design and graphics are used to influence purchasing decisions at the retail level.

Point-of-purchase packaging offers a number of advantages: it is less expensive than advertising and promotion, substitutes for experienced sales personnel in mass merchandise outlets, and reinforces the trend in retail sales toward impulse buying. One study recently found that two-thirds of all buying decisions in supermarkets were made in the store, Ernst noted.

FIGURE 2: **Leading kraft linerboard.**



Source: International Paper Co.



Maintain accurate control of liquid & slurry processing with Solartron® on-line densitometers.

Solartron® densitometers provide continuous, repeatable measurement of density-related parameters of process liquids and slurries, under actual process conditions. This allows better maintenance of ratios for product mixtures, improved efficiency of operations, reduced waste and automation of process operations. Our straight-through, zero-maintenance design minimizes response time and is insensitive to vibration or mounting position. The system provides both digital and analog outputs for alarm indication at specified levels, data logging, and system control loop interface.
For measurement of line density ▲ specific gravity ▲ percent concentration ▲ mass flow ▲ degrees Brix ▲ degrees Baumé ▲ any density-related parameter.

Schlumberger Industries

11321 Richmond Ave., M-102, Houston, TX 77082-2615
713-558-2587 • FAX: 713-558-8954

On Reader Service Card **Circle 137**

He said four categories of board currently serve the point-of-purchase display market:

- Litho-laminating is the result of high-quality coated paper being preprinted and then laminated to corrugated board. This is the most expensive technique but offers the highest graphic quality.
- Coated board is used primarily in the preprint process before linerboard and medium is combined into sheets. Graphic quality is high and cost can be lower than litho-laminating if production runs are large enough. However, minimum order size forces box plants to make runs beyond the immediate order and makes it expensive for the end user to change design quickly. Capacity for preprint has grown rapidly in the last five years but still has not resolved its marketing problems. As a result, consumption of coated board is still believed to be small.
- Bleached linerboard is used in preprinting and postprinting (the typical process in which printing follows corrugating). Graphic quality is lower, but the market is well established and growing. In 1987, U.S. uncoated solid bleached linerboard production totaled 137,000 tons and has been growing at a 4.4%/year rate since 1980. As preprint process grows, bleached and coated linerboard demand should rise sharply, Ernst said.
- Mottled linerboard is by far the largest type of linerboard used to improve graphic display. It is used in either preprint or postprint to upgrade brown boxes or as an inexpensive substitute for uncoated bleached board. The irregular surface of most mottled linerboard limits its use as a satisfactory printing surface. However, U.S. production of mottled in 1987 exceeded 1 million tons and has been growing at a 7.7%/year rate since 1980. It has the lowest cost of the four types of board now used for making point-of-purchase displays and boxes.

Chesapeake plans to use its new No. 3 machine to produce two new grades to better serve this market. Already this spring, the company began producing Tri-Lite, an improved mottled liner that is said to offer greater surface uniformity. Its three-ply structure also offers better compression strength. The company is additionally developing Tri-Brite, a white-top board, which will compete with solid bleached linerboard.

The new white-top board "should be ideal for the preprint market, which is still looking for a low-cost substrate that can open up the volume end of the high-quality graphics market," Ernst said. The company hopes to introduce the new grade in the second half of 1988 and has projected that about 20% of its paperboard volume in 1987 will consist of the two white grades.

Ernst also indicated that the company is solving some earlier operating problems with the complex Tri-Kraft machine. The machine, installed in 1986, has a capacity of about 315,000 tpy. Production rose from 65% of capacity at the beginning of 1987 to about 80% by the year's fourth quarter, and further improvement is being made this year. ■